APPENDIX 4

General HUD Material

Background

This material was assembled by the FGSHWG in the conduct of its work developing criteria relating to the guidance aspects of Head Up Displays [HUD]. The following material is considered 'generic HUD criteria, not guidance, and is more appropriately addressed in AC/AMJ 25-11. The FGSHWG is providing this information to TAEIG with the request that it be forwarded to the working group that will work on an update to AC/AMJ 25-11 for consideration in their work.

HUD Characteristics

Restrictions on view

When installed, whether in use or not, the HUD equipment must not create additional obstructions to the pilot's required external field of vision (see JAR 25.773 (a)(1)). The equipment must not restrict the pilot's view of any controls, indicators or other flight instruments.

Restrictions on movement

The HUD equipment must not hinder the movement of the pilots whilst carrying out their normal tasks and emergency procedures, entering or leaving the cockpit, or during emergency egress.

Additional hazards

The HUD equipment must not increase significantly the likely-hood of injury to the pilots in the event of an accident (see JAR 25.785c(2)). It must not present dangers under normal operating conditions or abnormal conditions (e.g. dazzle, high voltage, implosion, projection, un-pressurized flight, presence of smoke).

External lighting levels

The display must be visible in expected operational light levels and against expected operational external scenes. Manually selectable and automatically maintained brightness control suitable for day and night operation must be provided.

Field of view

The binocular instantaneous field of view (IFOV) must not be unduly sensitive to the position of the pilot's head in the wind and turbulence conditions. In the event of a total loss of the display as a result of head movement, the pilot must be able to regain the display symbology rapidly and without difficulty.

From the Eye Reference Point (ERP), the azimuth Instantaneous Field Of View (IFOV) must be sufficient to allow the display to be used without display limitations at the crosswind certified for approach operations in combination with the critical engine inoperative when the airplane is trimmed out.

Optical performance

The HUD combiner and the windshield together must not cause significant optical degradation or distortion of the pilot's view of the outside world.

Symbology design

The designed symbol set (size and font) must be clear and uncluttered and enable easy assimilation of the displayed information. It must have no features that might lead to confusion or to an error by the pilot.

The display format must contain features minimizing the possibility of pilot fixation on the symbology when the aircraft is near the ground.

There must be clear and unambiguous indication to the pilot of pitch and bank. If non-conformal positioning of normally conformal display elements occurs (e.g. horizon line and flight path vector), this must be clearly indicated.

Symbology hierarchy

A symbology hierarchy must be established such that higher priority symbology clearly and unambiguously overwrites lower priority symbology.

Outside world view

As far as practicable the display must not degrade, distort or detract from the pilot's view of the runway or of other aircraft. If an artificial runway or other external ground references are provided they must correlate with the real world as seen by the pilot.

Brightness Variation

The brightness of the outside visual scene may be considered to range from 100 to 8000 foot lamberts over a time period of 5 seconds and from 5 to 1000 foot-lamberts over a similar time period. Manual control of the HUD brightness level should be available to provide compensation beyond this range and to provide the means to set a reference level for automatic brightness control.

Color HUD

As for any color HUD, care must be taken that the interaction of the HUD colors and the background (i.e., out the window) color of lights and terrain does not create confusion for the pilot. Real world color shift should not be misleading.